Respiratory Health Impacts of Airborne Particles

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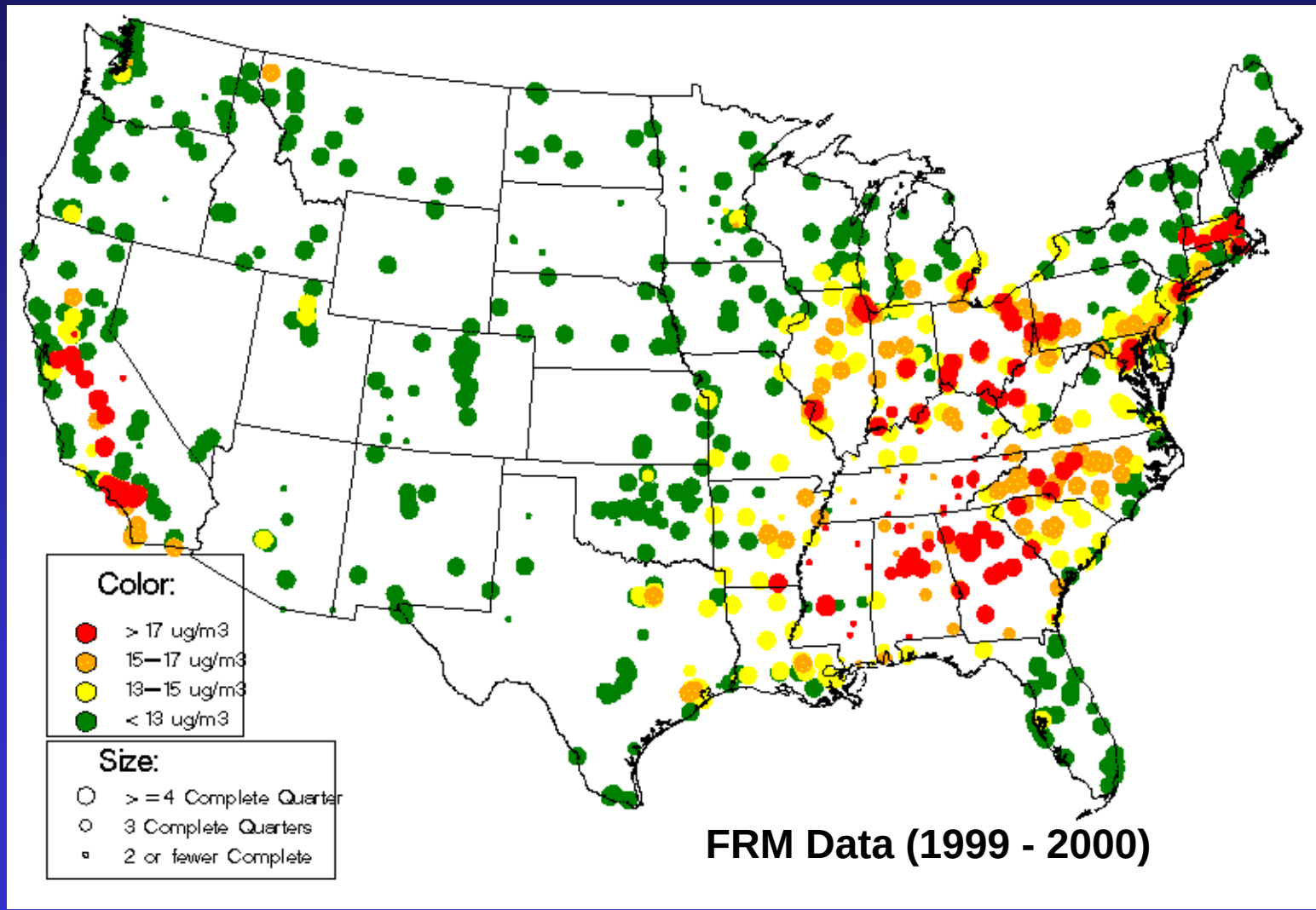
Annual Average PM2.5 Concentrations



We Know PM Air Pollution Causes Health Effects

- Epidemiology Studies
- Statistical Tools Look at Human Populations

- Mortality and Illness Track PM Levels
- High Degree of Consistency and Coherence
  Among Studies

- Effects are seen Worldwide

What We Still Need to Understand Regarding the Health Effects of PM Air Pollution

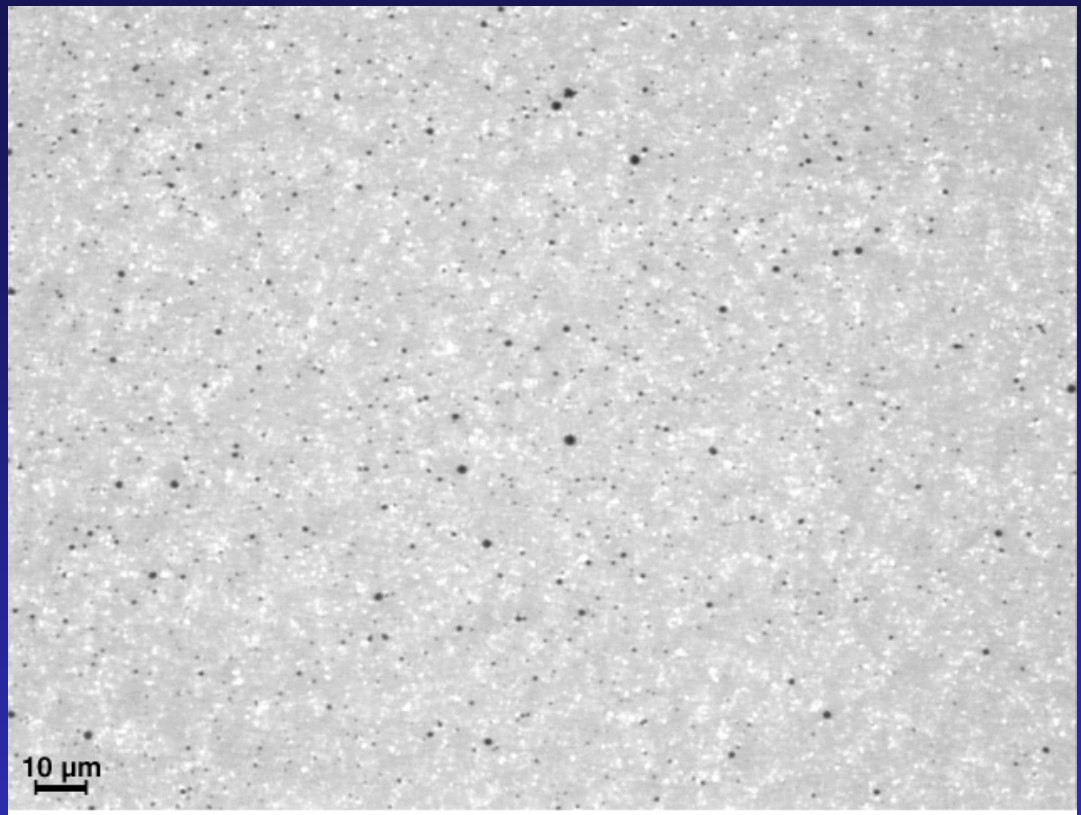
- Which Characteristics Are Most Important?
  - Particle Size
  - Particle Composition
  - Particle Number
- What Cellular Mechanisms are involved?
  - Allergic response
  - Immune response
  - Inflammation
  - Injury and repair

Biological Endpoints

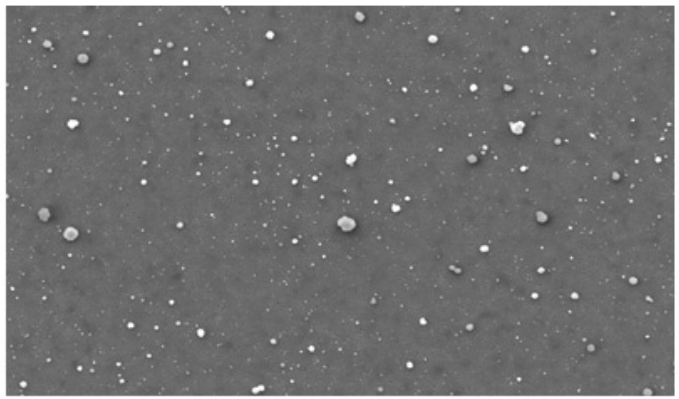
- **Cell Permeability (Injury)**
- **Cell Proliferation (Repair)**
- **Oxidative Stress**
- **Histopathology**
- **Injury Location**
- **Immunohistochemistry**
- **Immune Cell Responses**
- **Airway Inflammation**
- **Cellular Function**
- **Pulmonary Function**
- **Particle Clearance**
- **Asthmatic Symptoms**
- **Allergic Response (cellular)**
- **Cardiovascular Effects**

PM

Aerosol

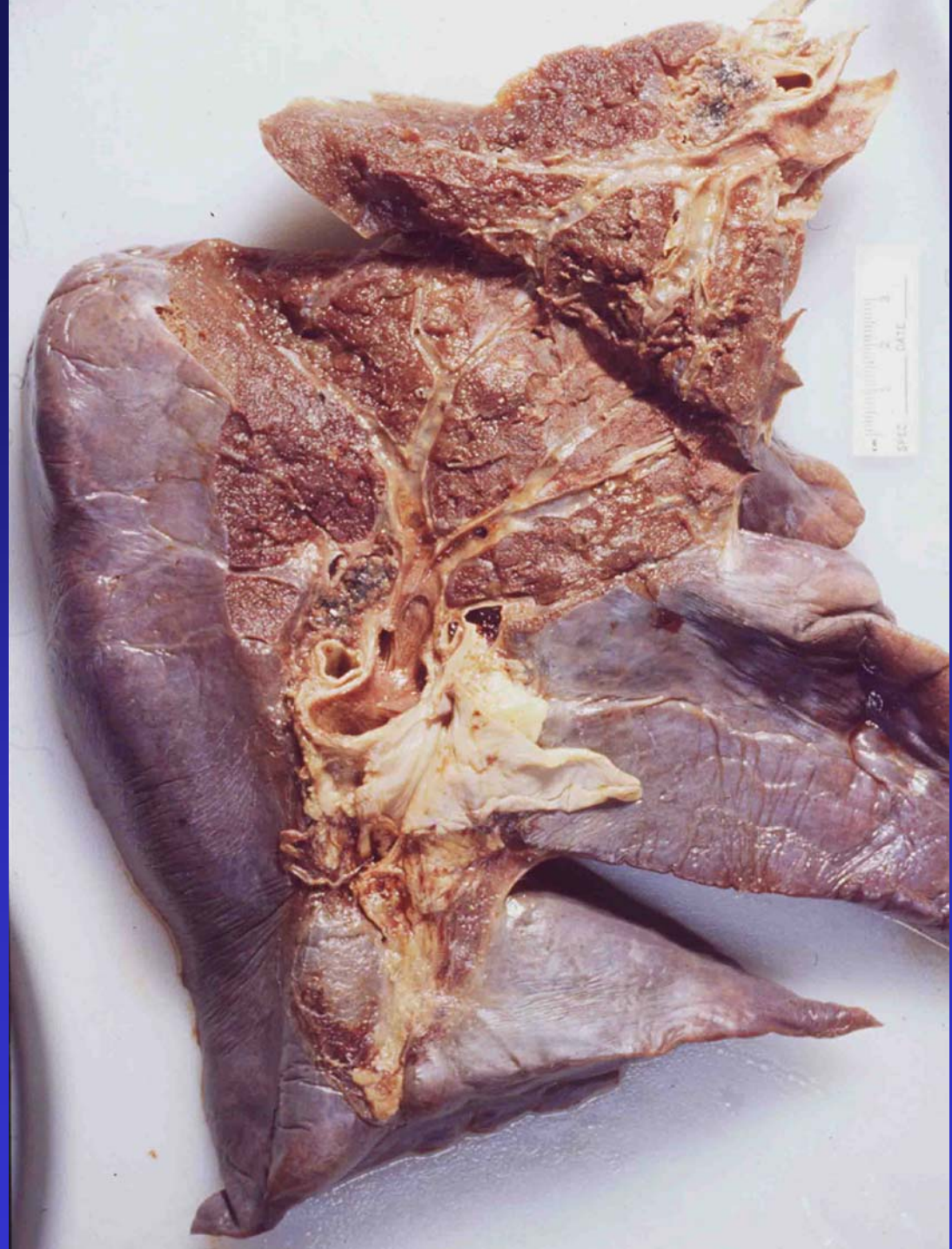


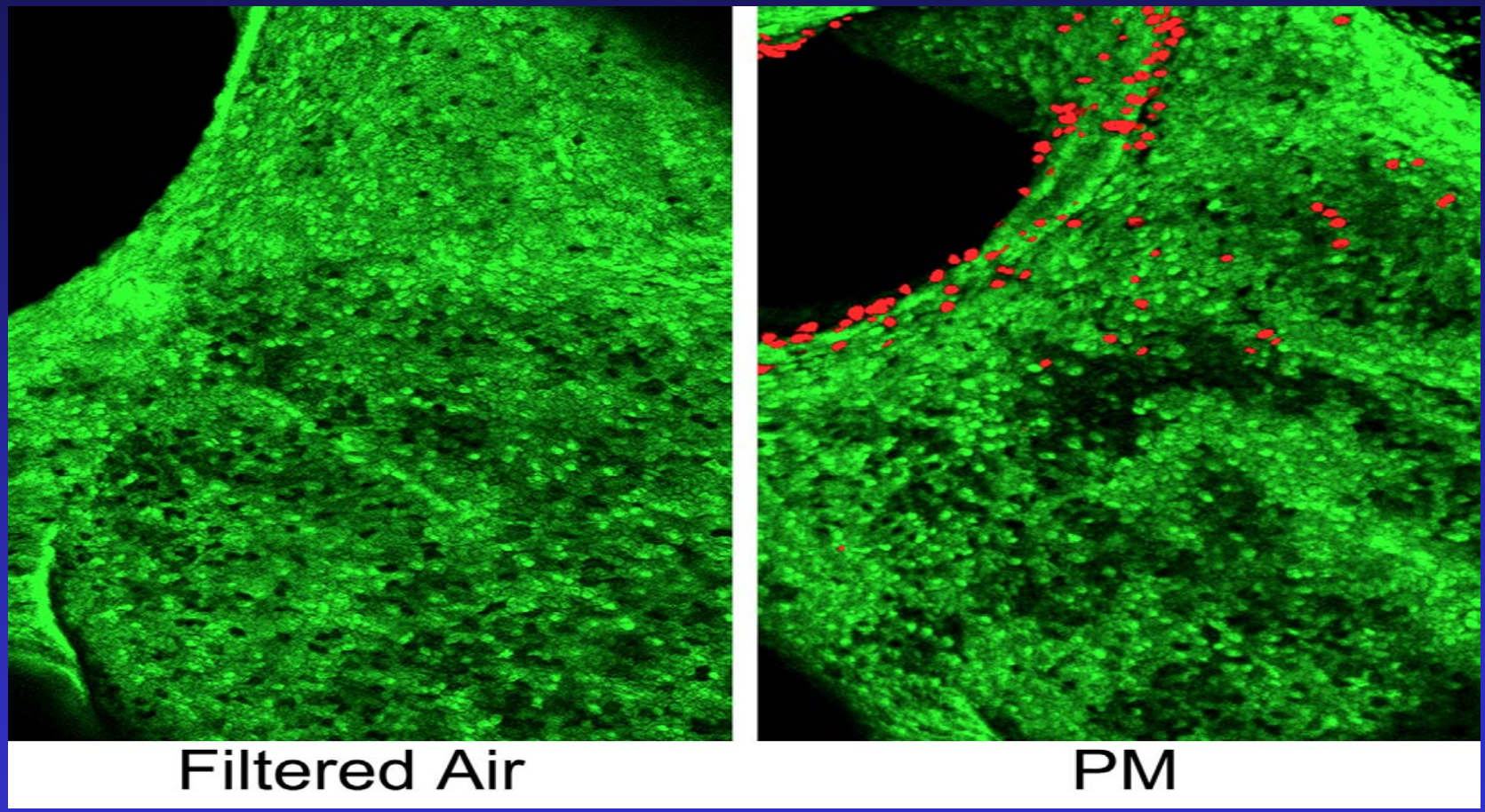
LM

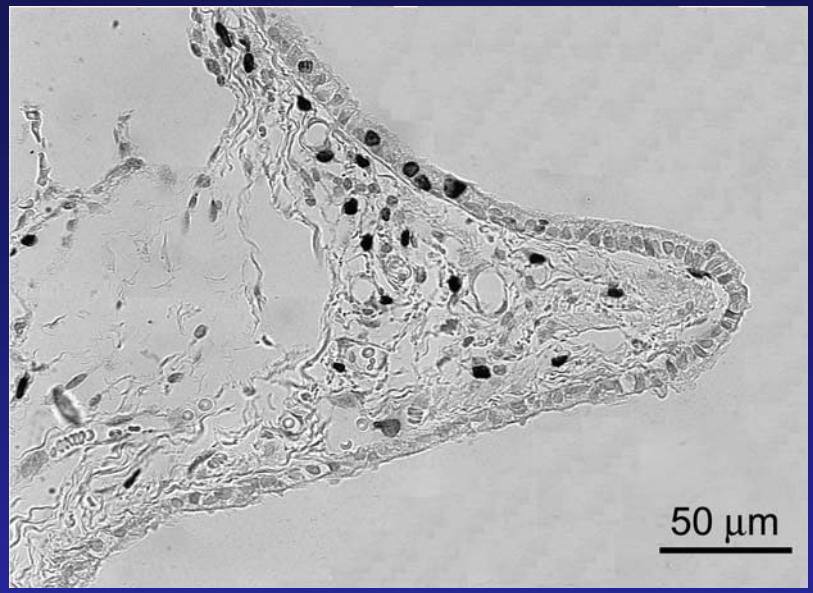


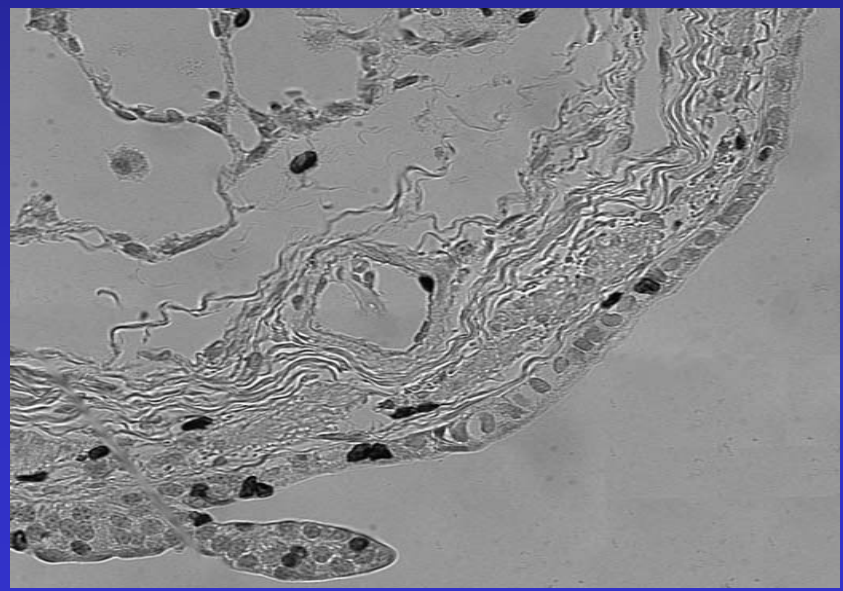
SEM

Airway Microdissection

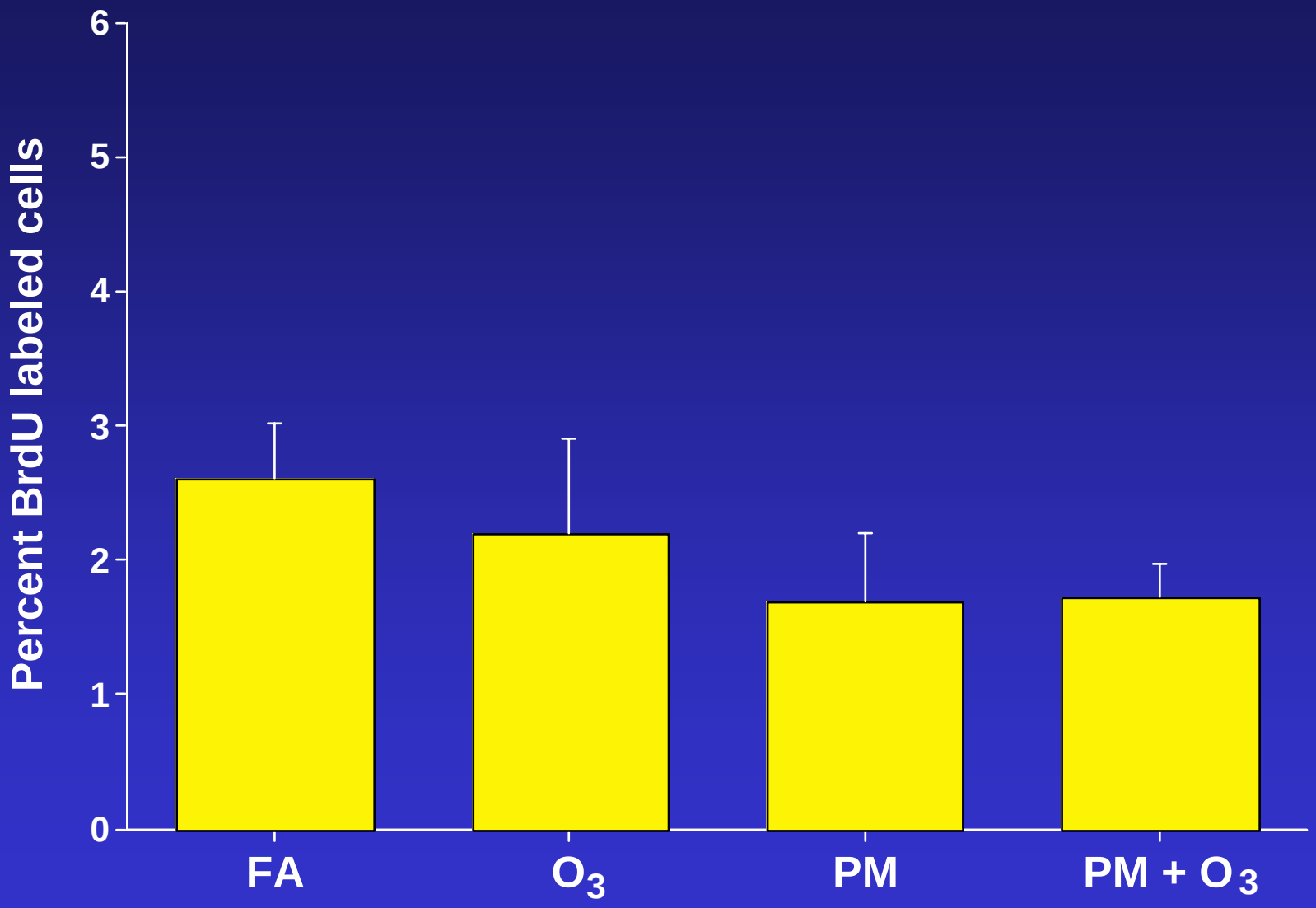



Filtered Air
PM

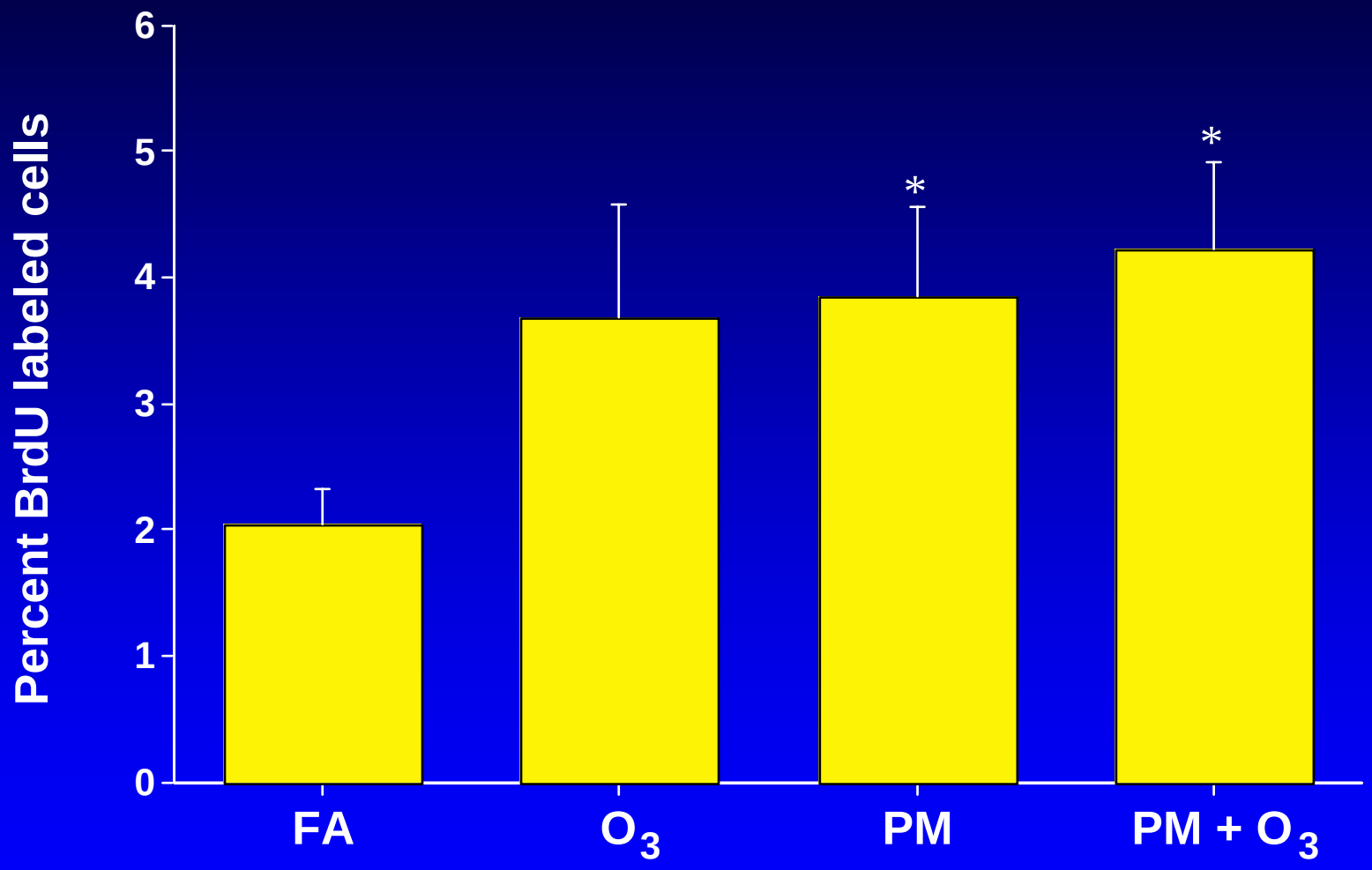

50 µm



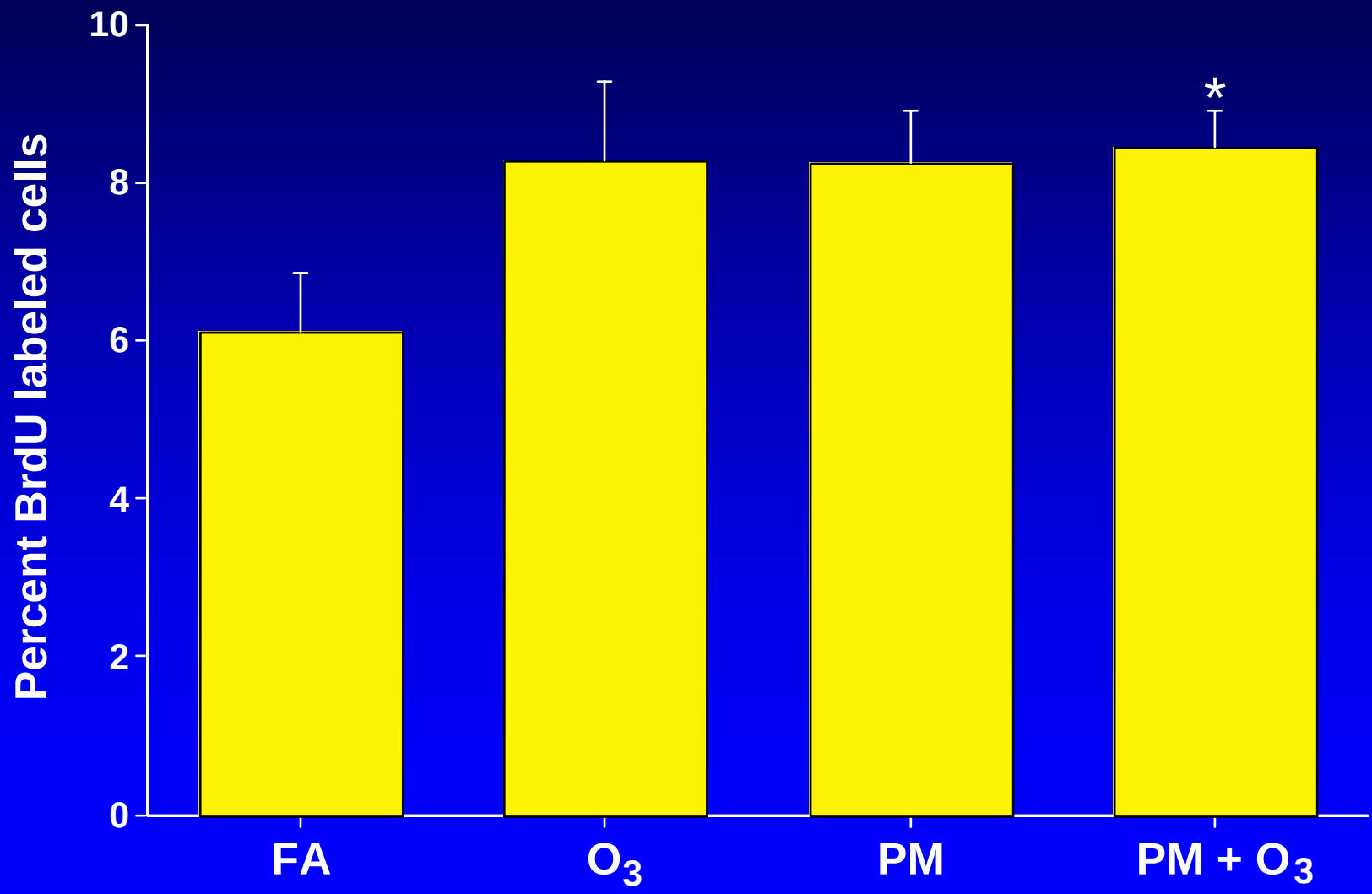
Epithelial cell labeling of airways



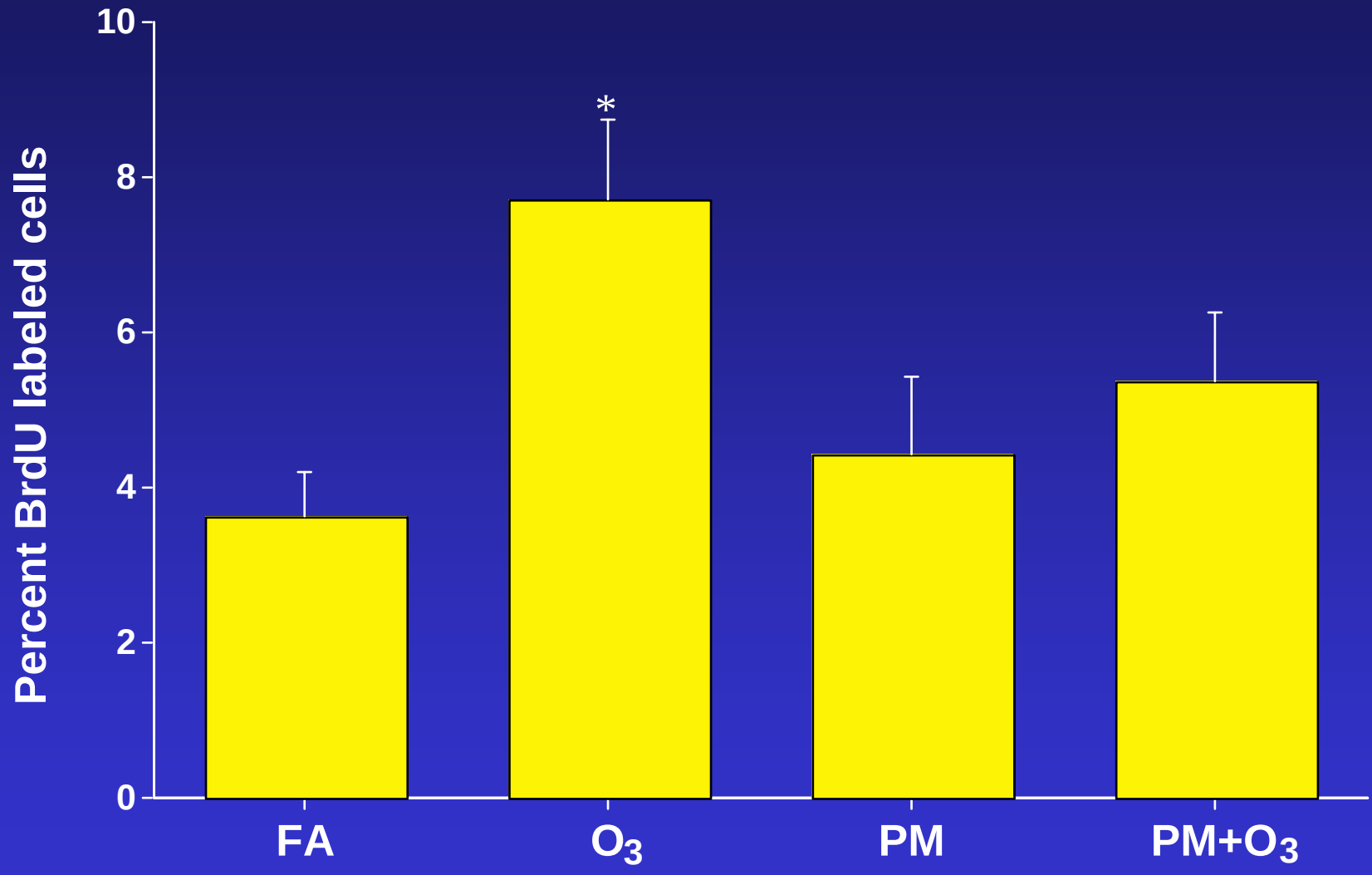
Epithelial cell labeling of airway bifurcations



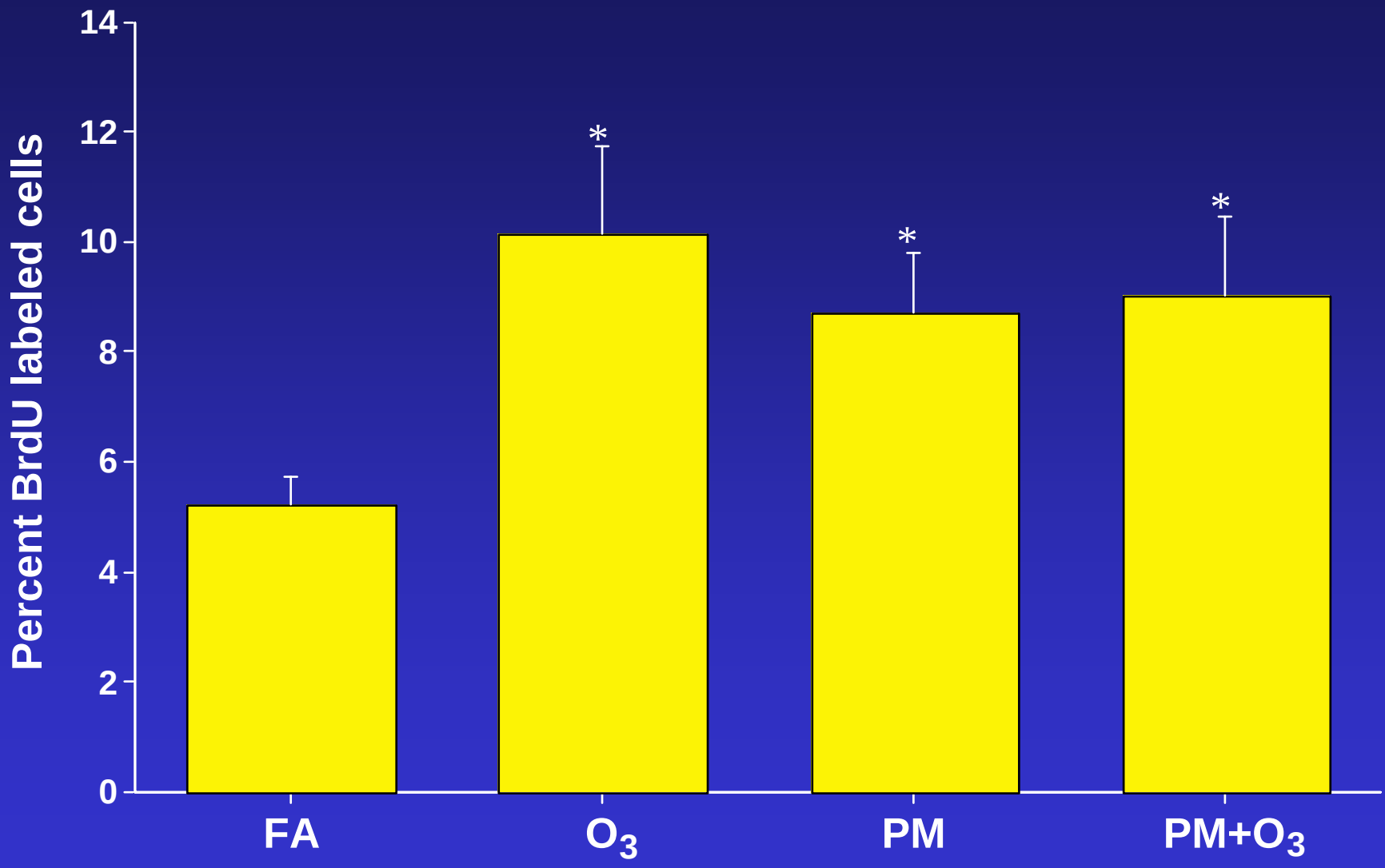
Interstitial cell labeling of airway bifurcations



Epithelial labeling of terminal bronchioles

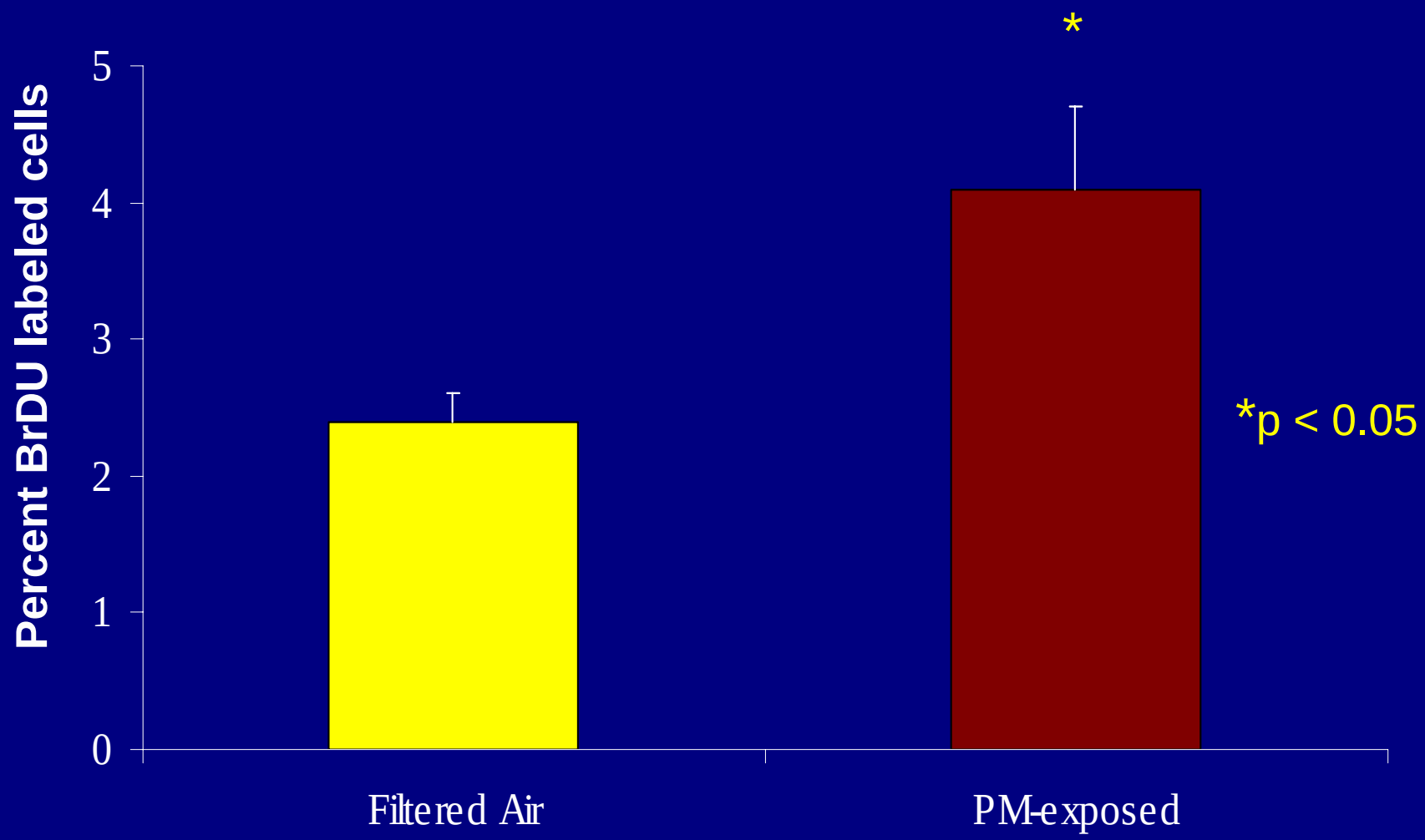


Cell labeling of the proximal alveolar region



Epithelial cell labeling of respiratory bronchioles in Rhesus monkeys

(PM = 150 µg/m ^{3} Nitrate + 100 µg/m ^{3} Carbon)



Studies of Concentrated Ambient Particles of the California Central Valley

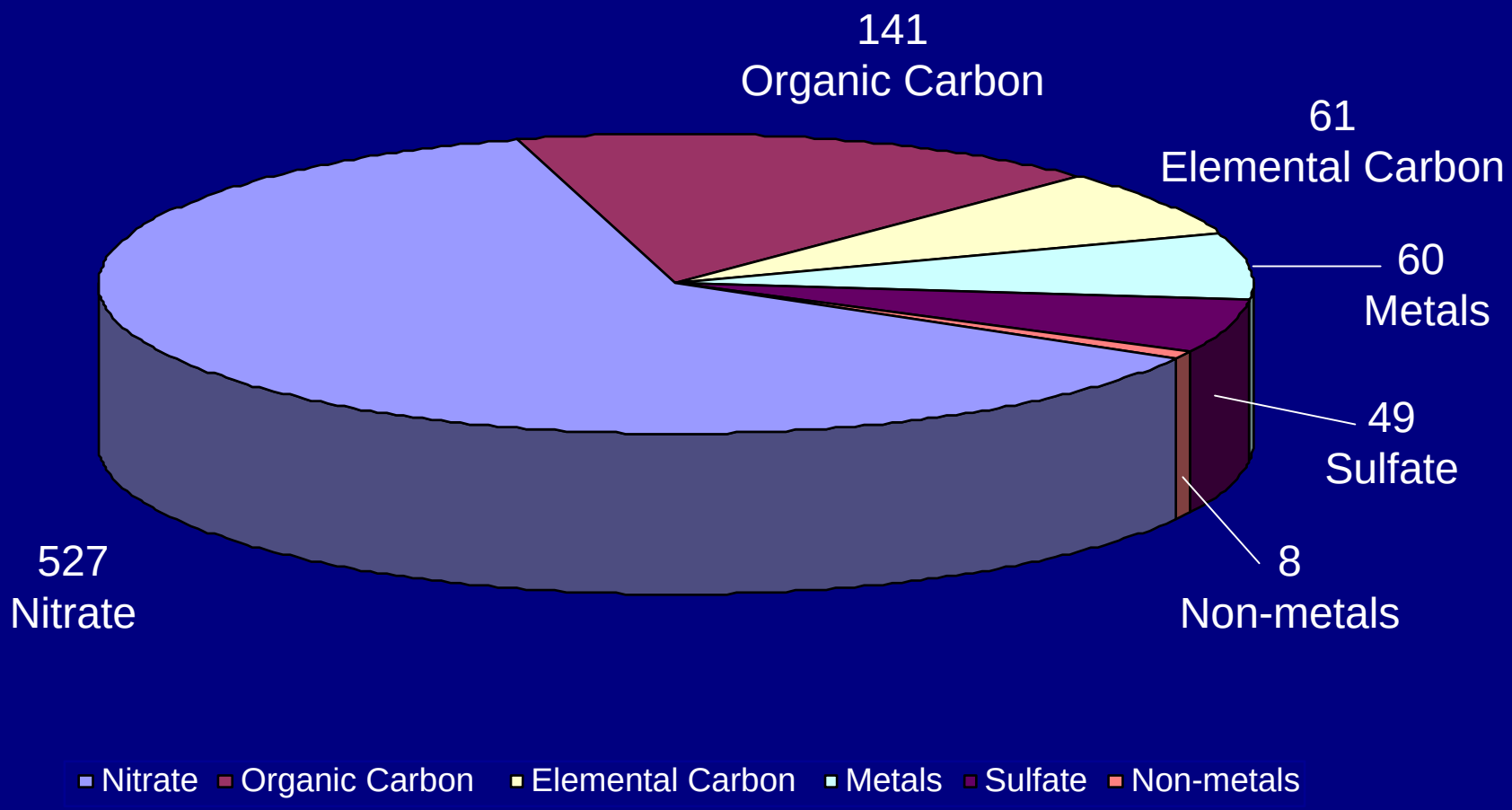
Concentrated Ambient Particles
Fall 2000, Fresno, CA

Date	Number/cc	Mass/m^3
Oct 17 - Oct 19	120,000	847
Oct 24 - Oct 26	120,000	260
Oct 31 - Nov 2	110,000	369

Chemical Composition of Fine Aerosol in Fresno

Oct 17-19, 2000

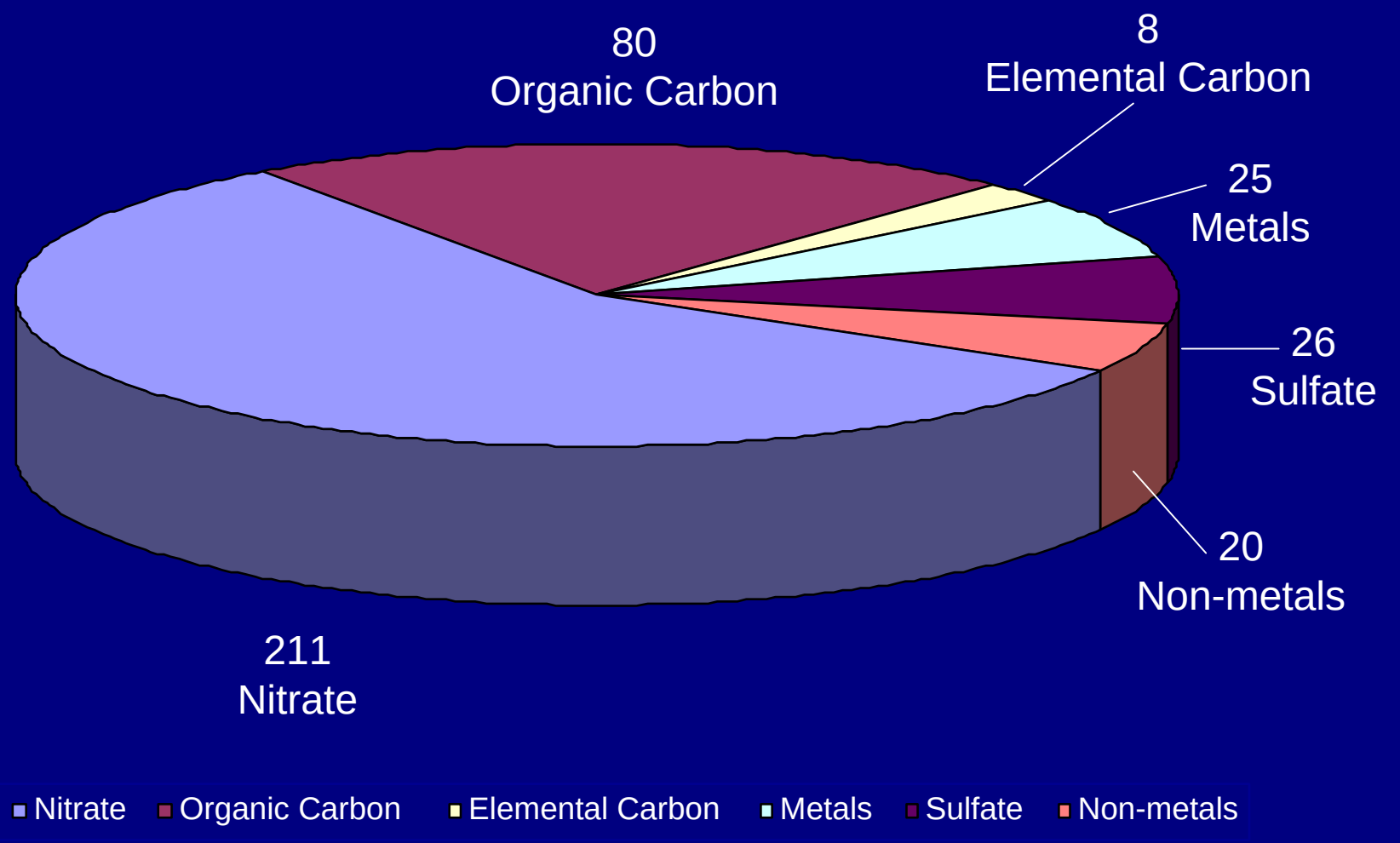
(Total Mass = 847 µg/m^3)



Chemical Composition of Fine Aerosol in Fresno

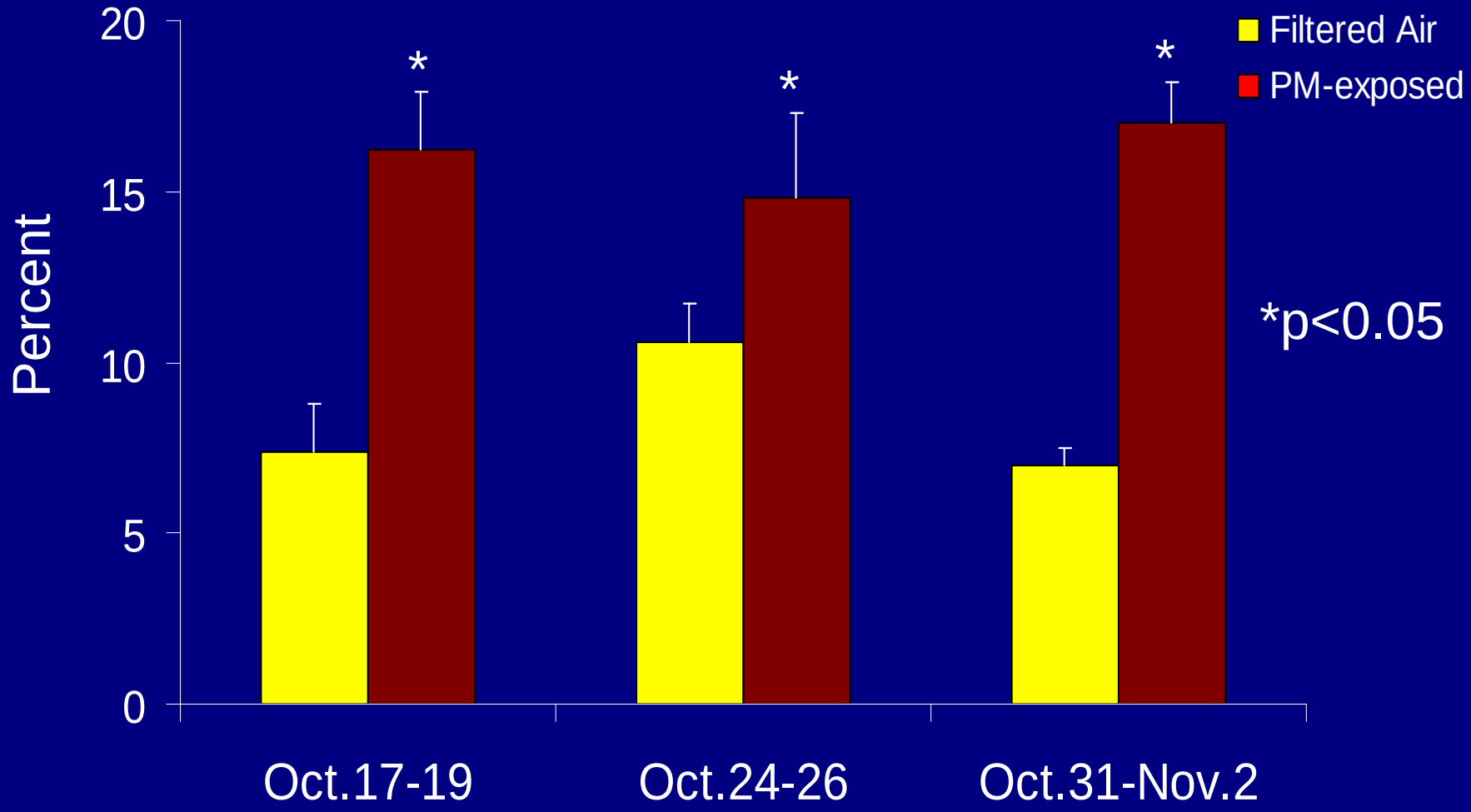
Oct 31- Nov 2, 2000

(Total Mass = 369 µg/m³)

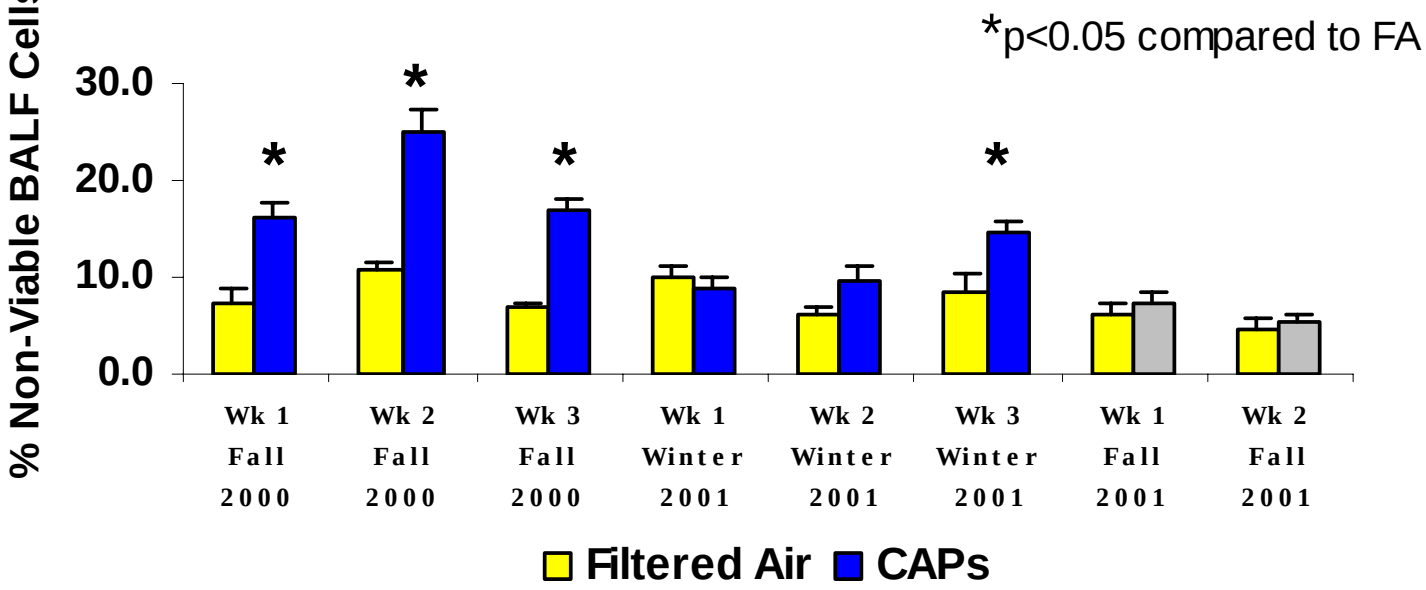


Fresno PM Study: Cell Permeability for Bronchoalveolar Lavage

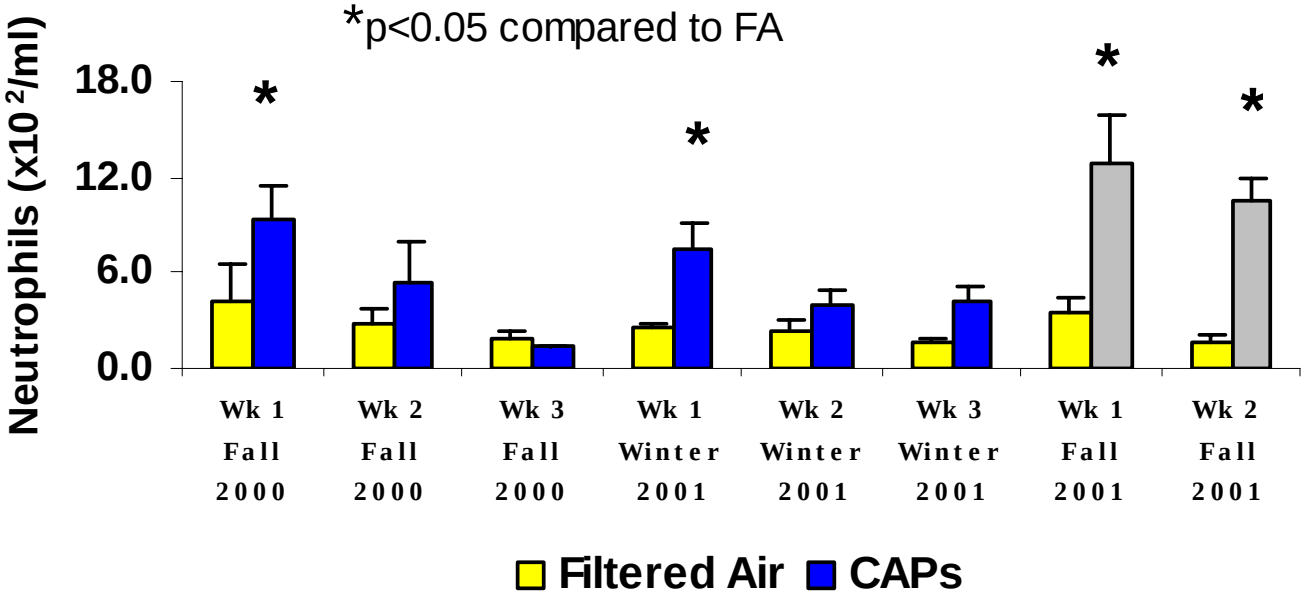
Fall, 2000



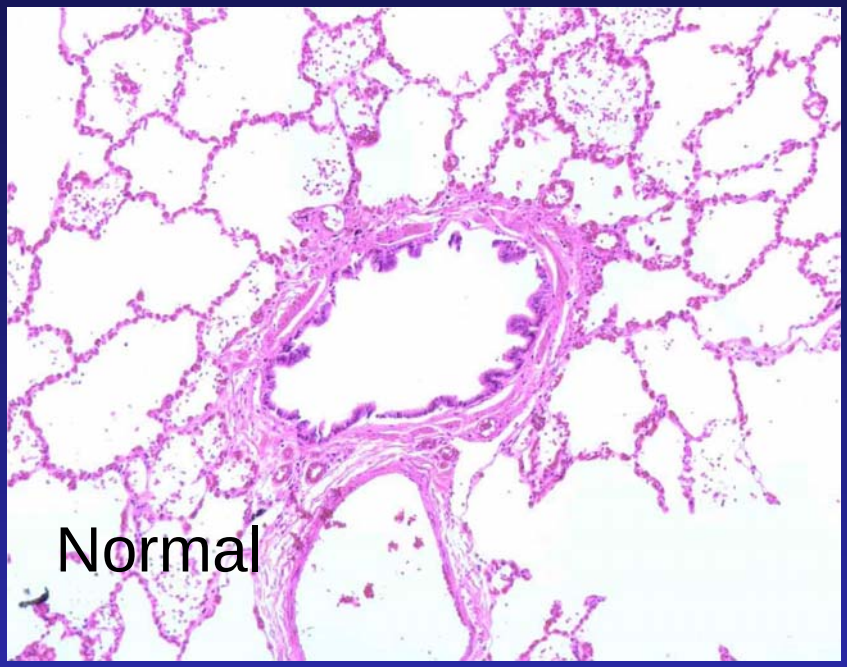
Non-Viable Cells in BAL from SD Rats Exposed to Fine or Coarse Aerosol in Fresno

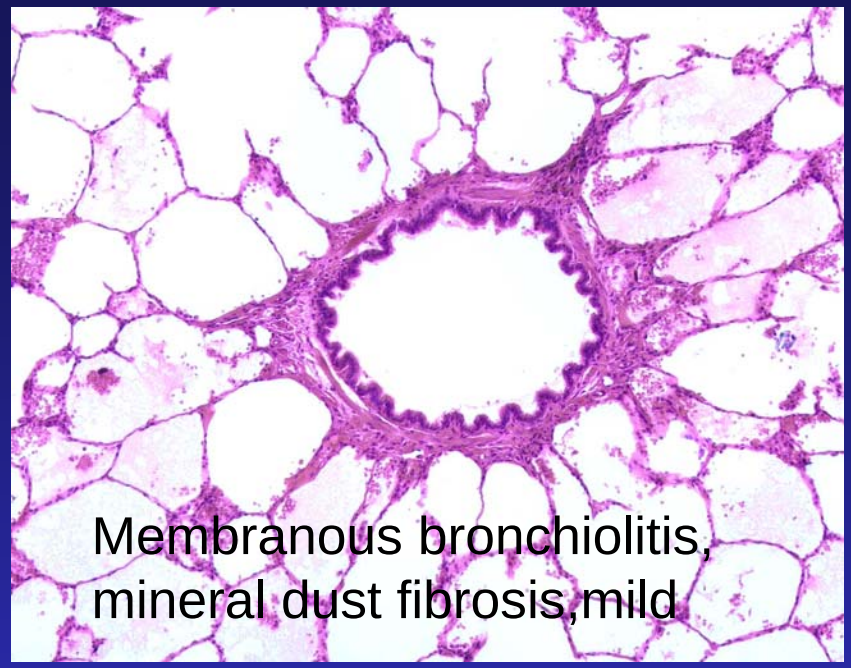


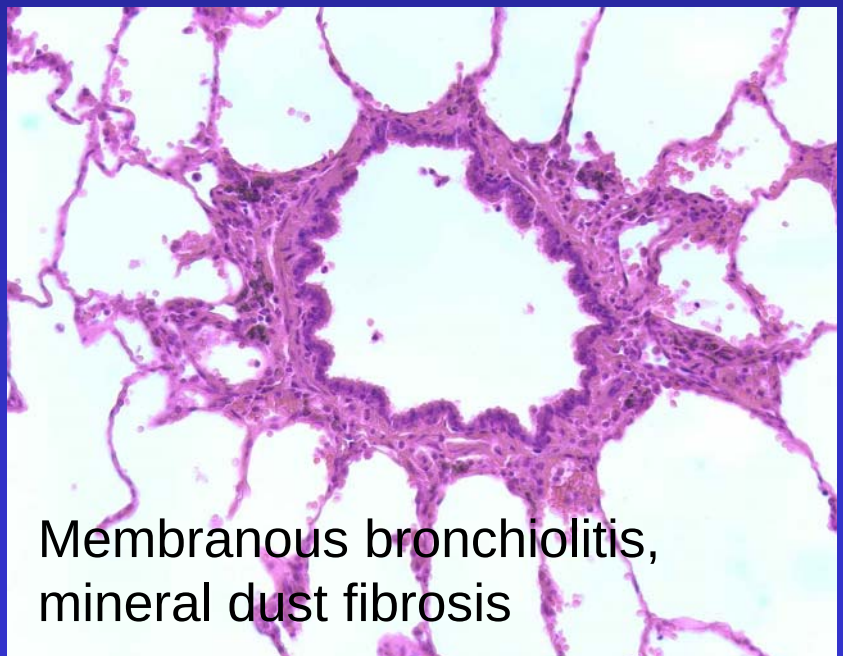
Neutrophils in BAL from SD Rats Exposed to Fine or Coarse Aerosol in Fresno



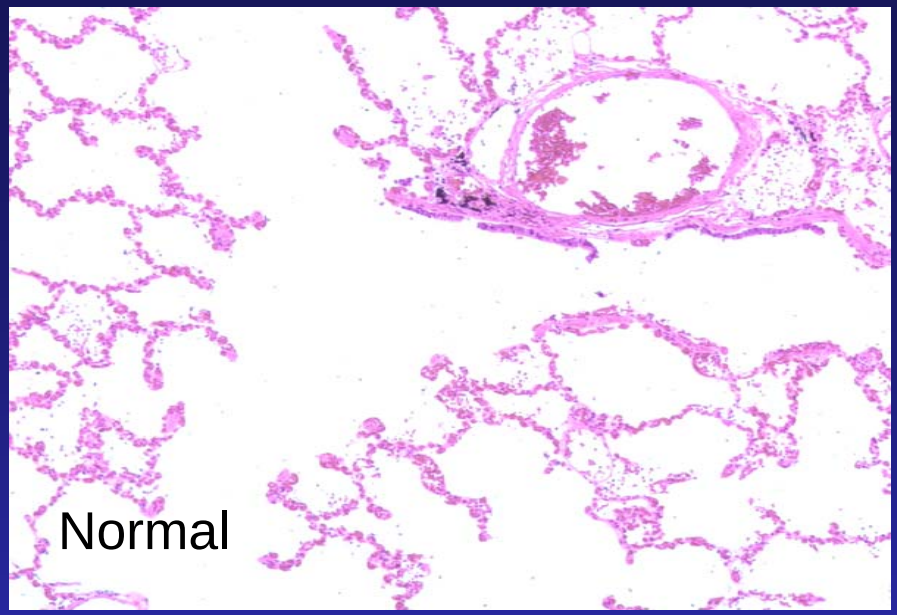
Membranous Bronchioles

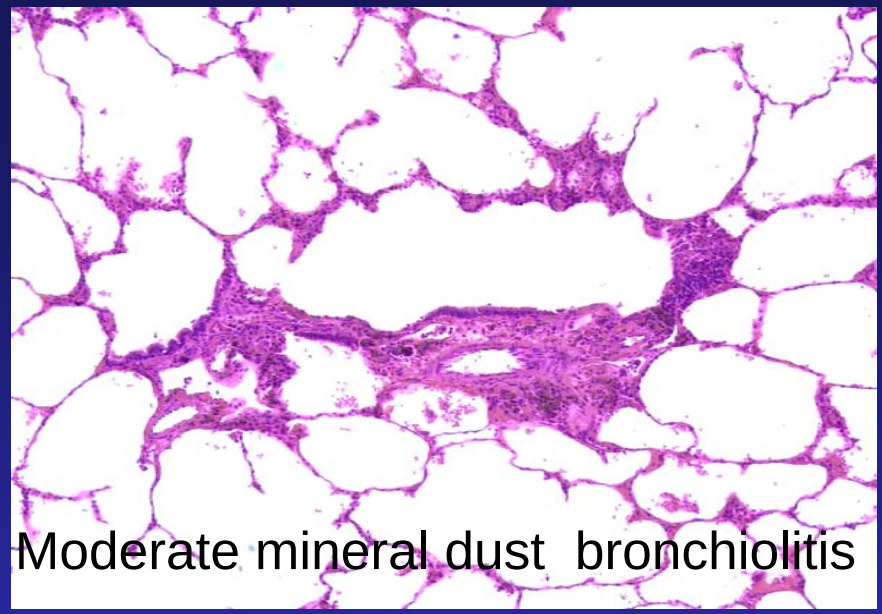


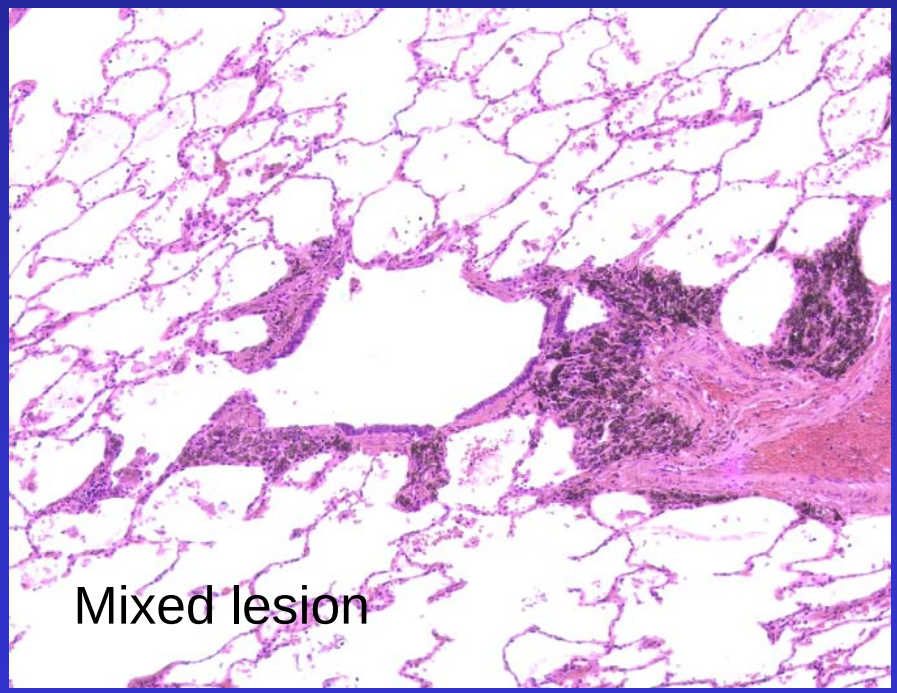


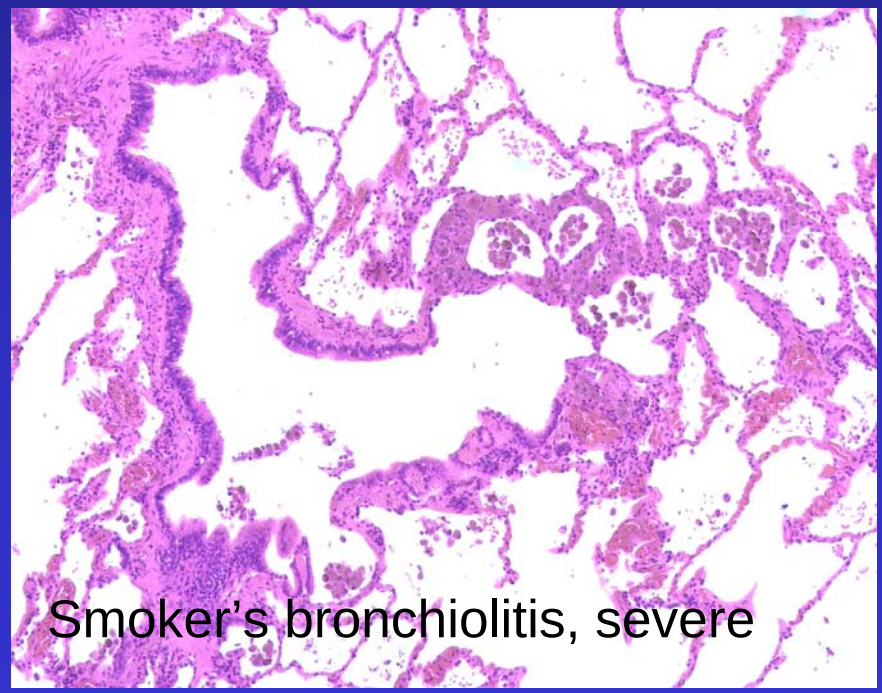


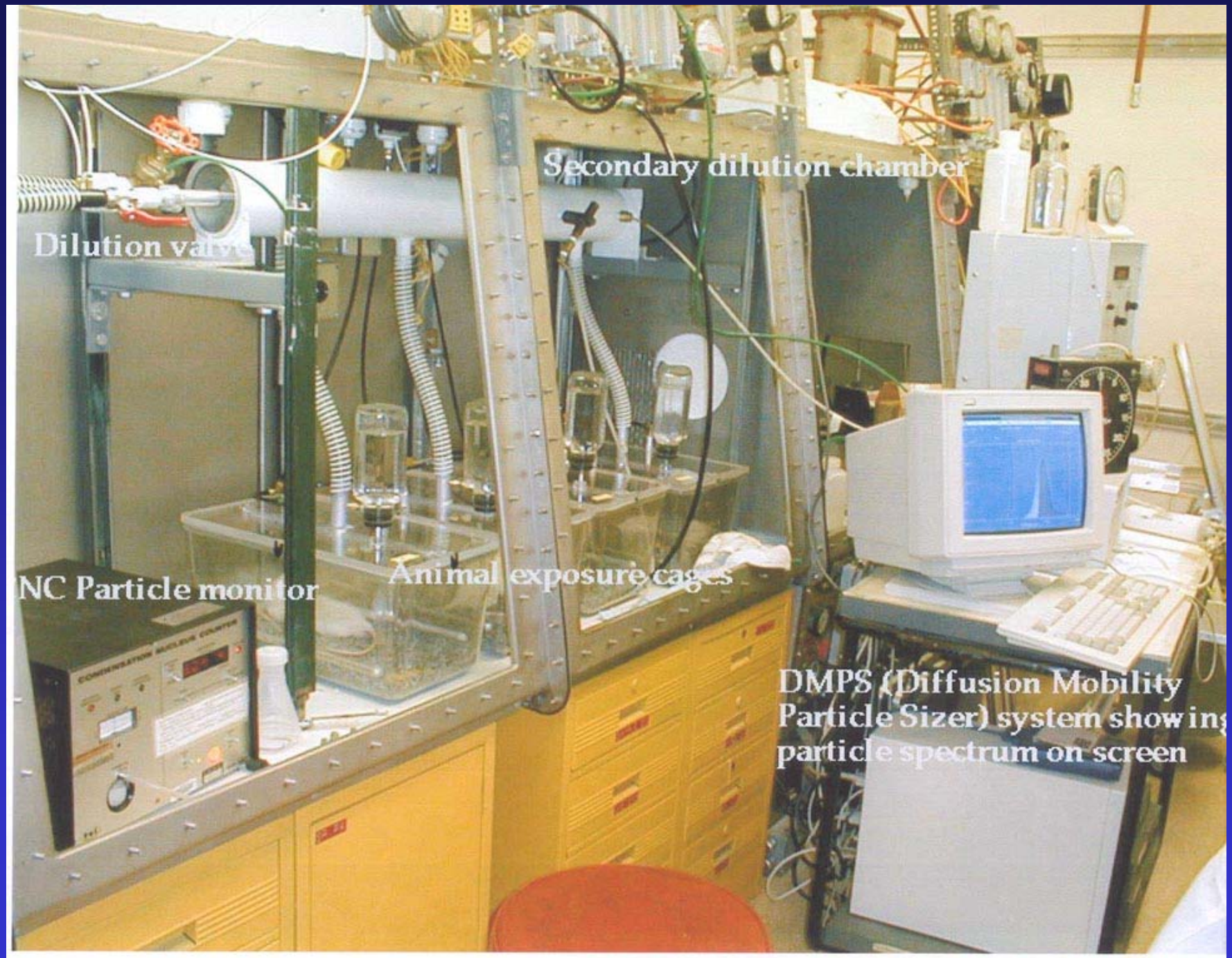
Respiratory Bronchioles





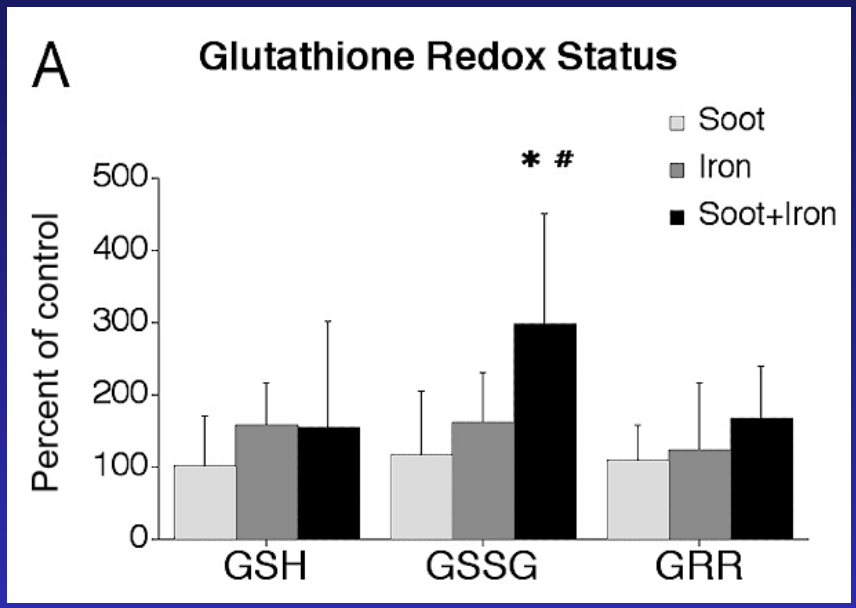




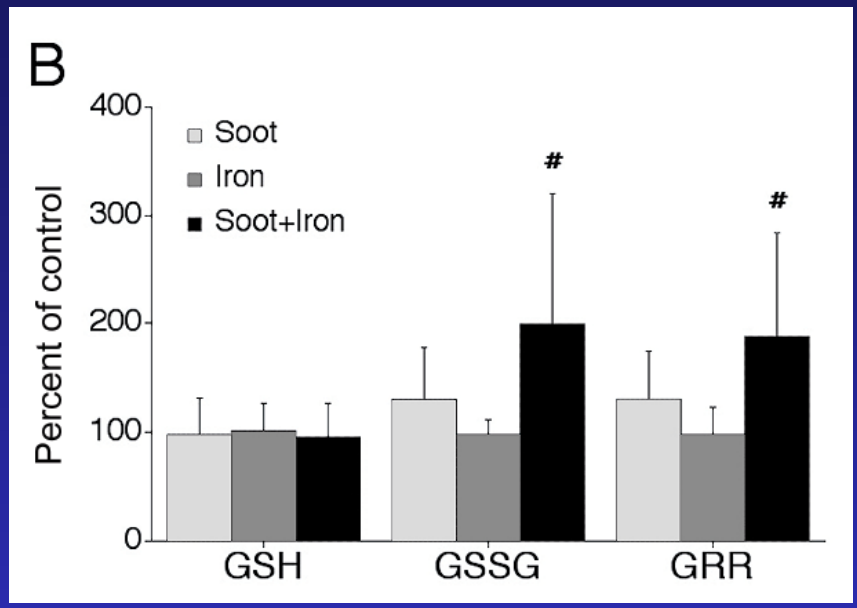

Secondary dilution chamber
Dilution valve
NC Particle monitor
Animal exposure cages
DMPS (Diffusion Mobility Particle Sizer) system showing particle spectrum on screen

No change in phase or nanoparticle size
Change in agglomerate size!
Change in chemistry in soot or nanoparticle surface? - EELS

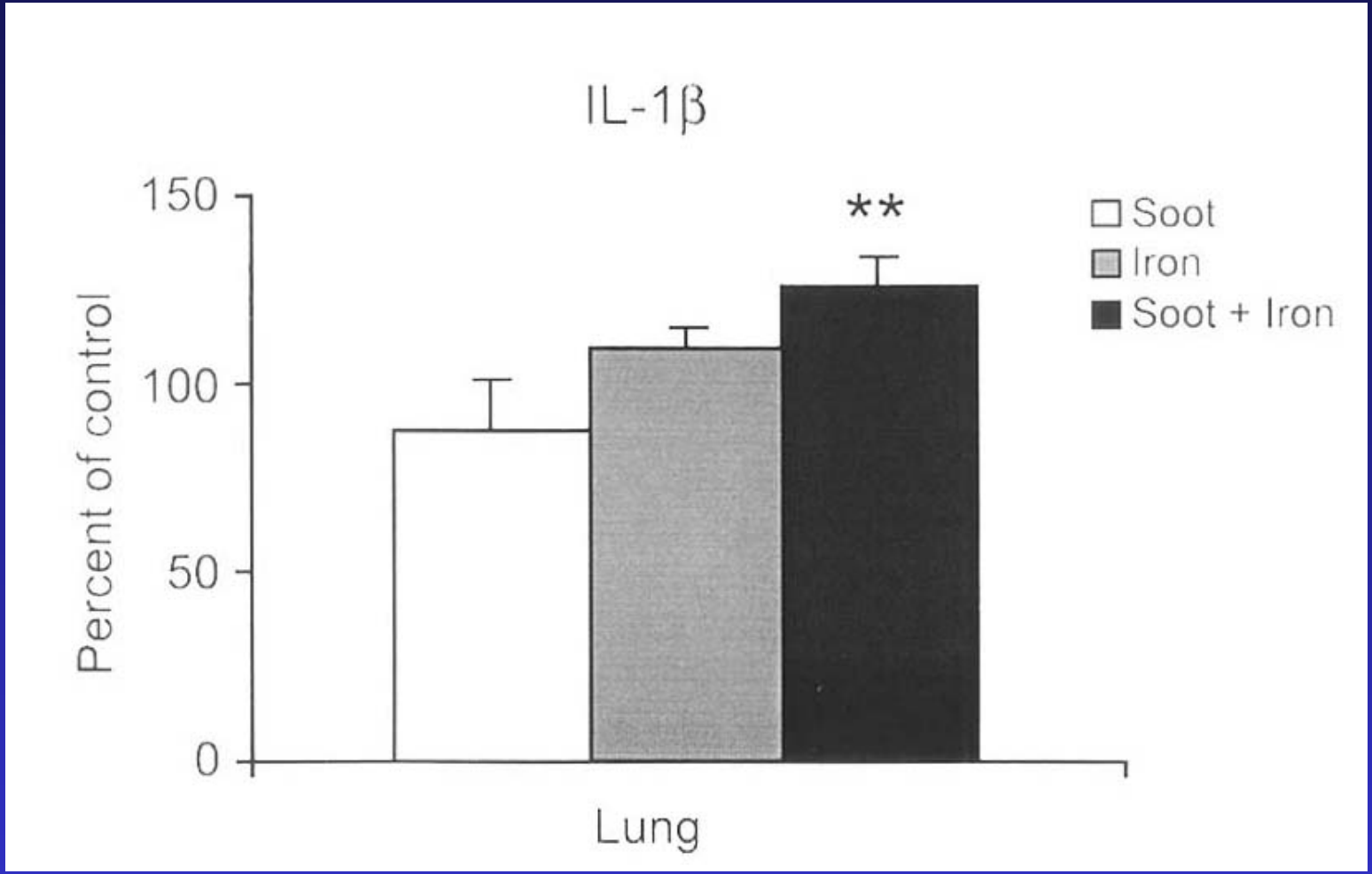
BAL



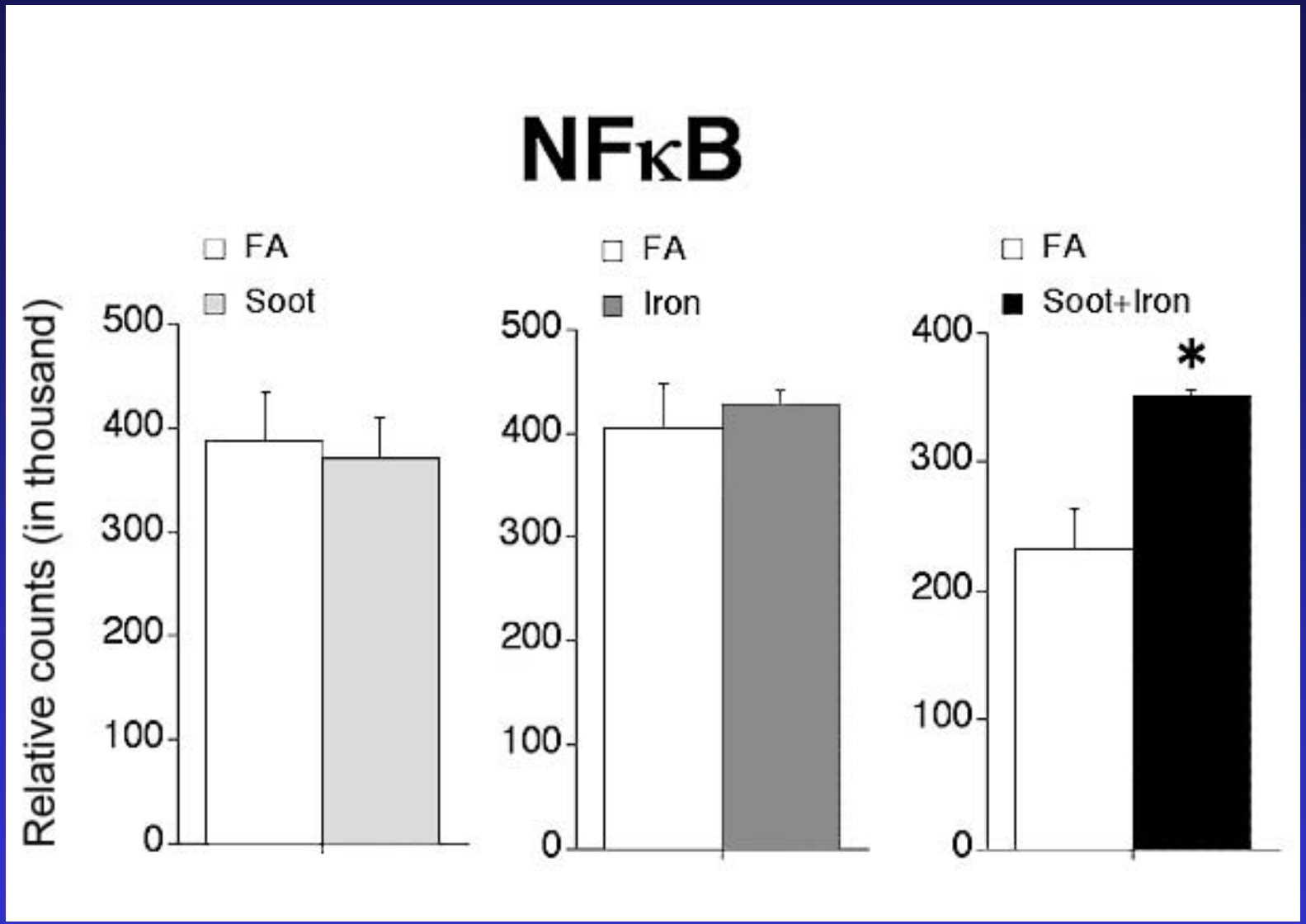
Lung



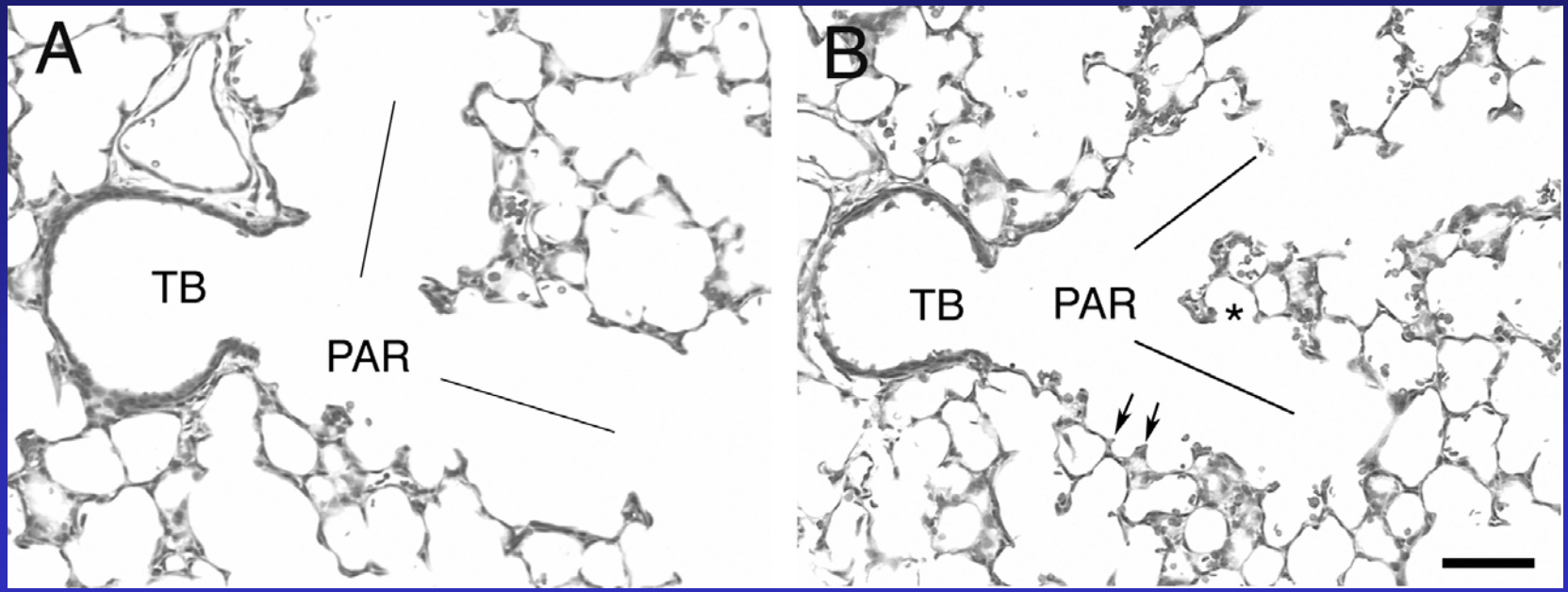
*P<0.01 compared to soot
#P<0.05. compared to iron

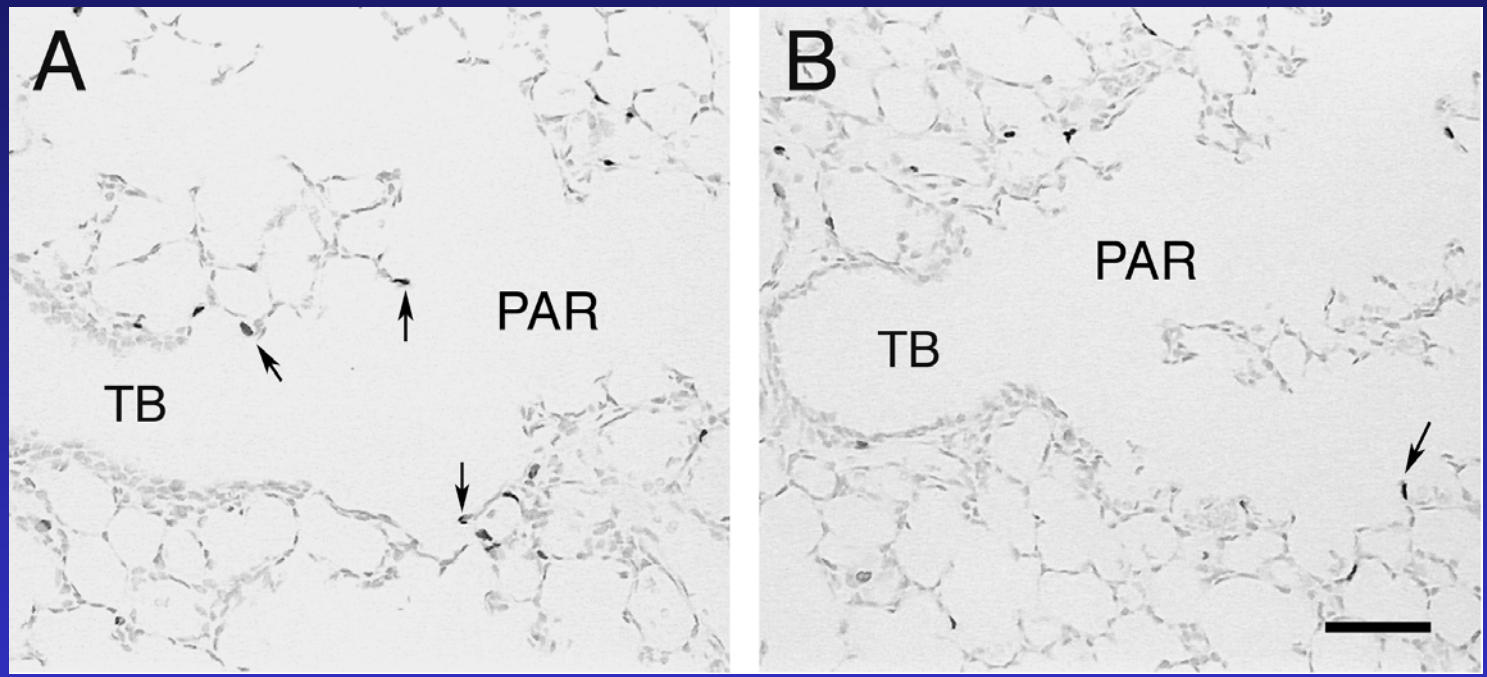


**p<0.01 when compared with soot + iron.

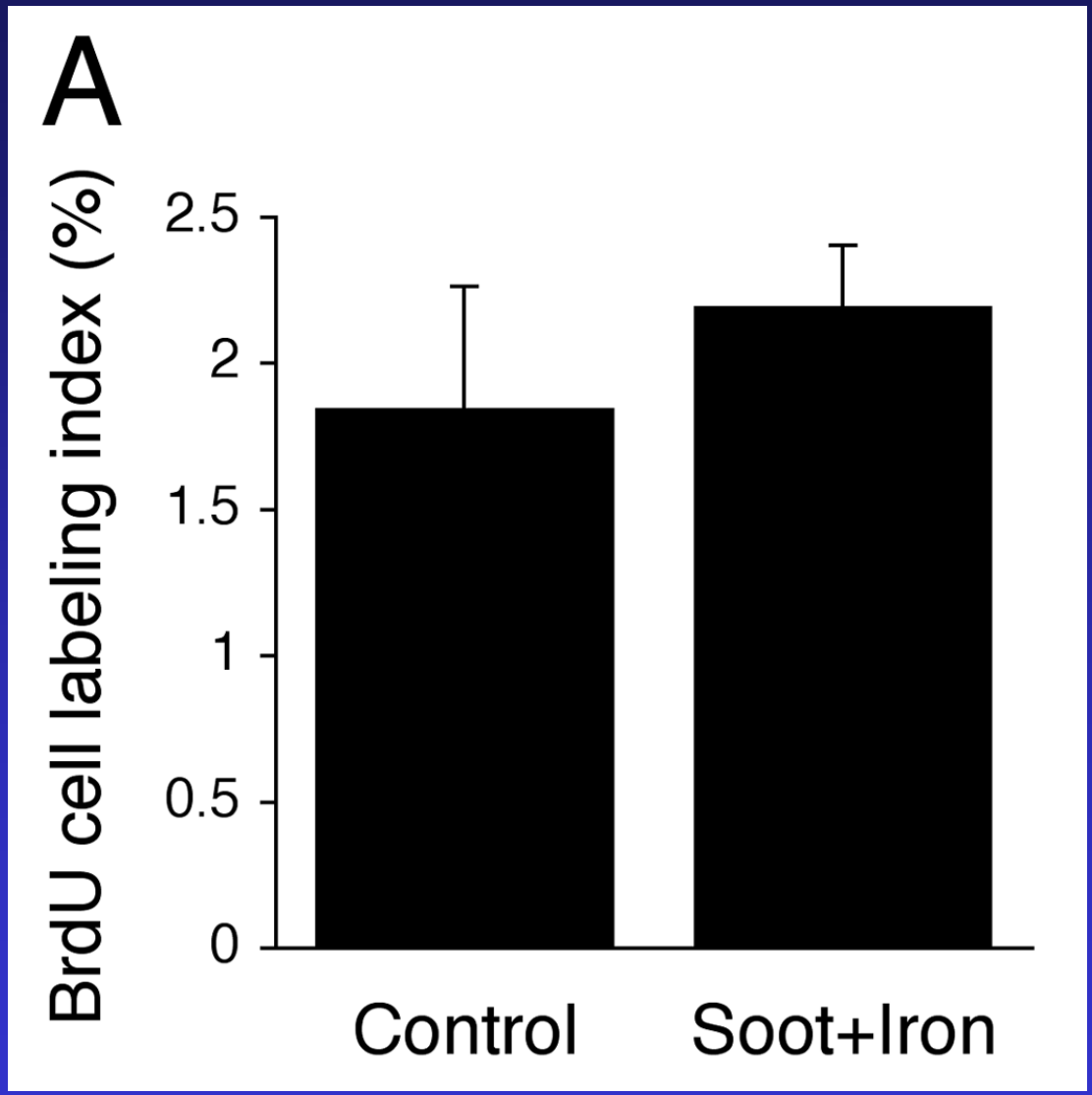


*P<0.01 compared with FA (control)

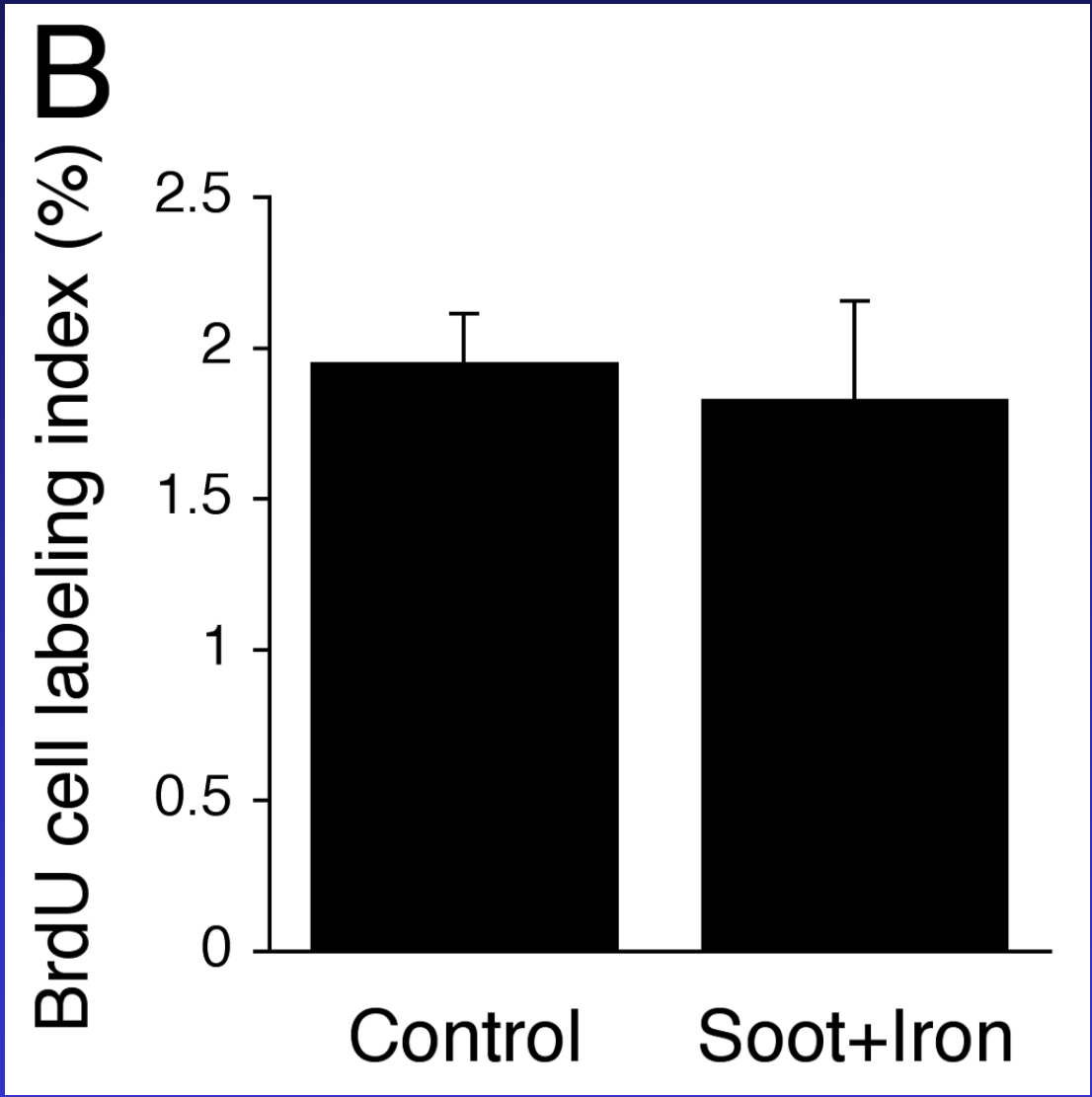

A
TB
PAR
B
TB
PAR
*


A
PAR
TB
B
PAR
TB

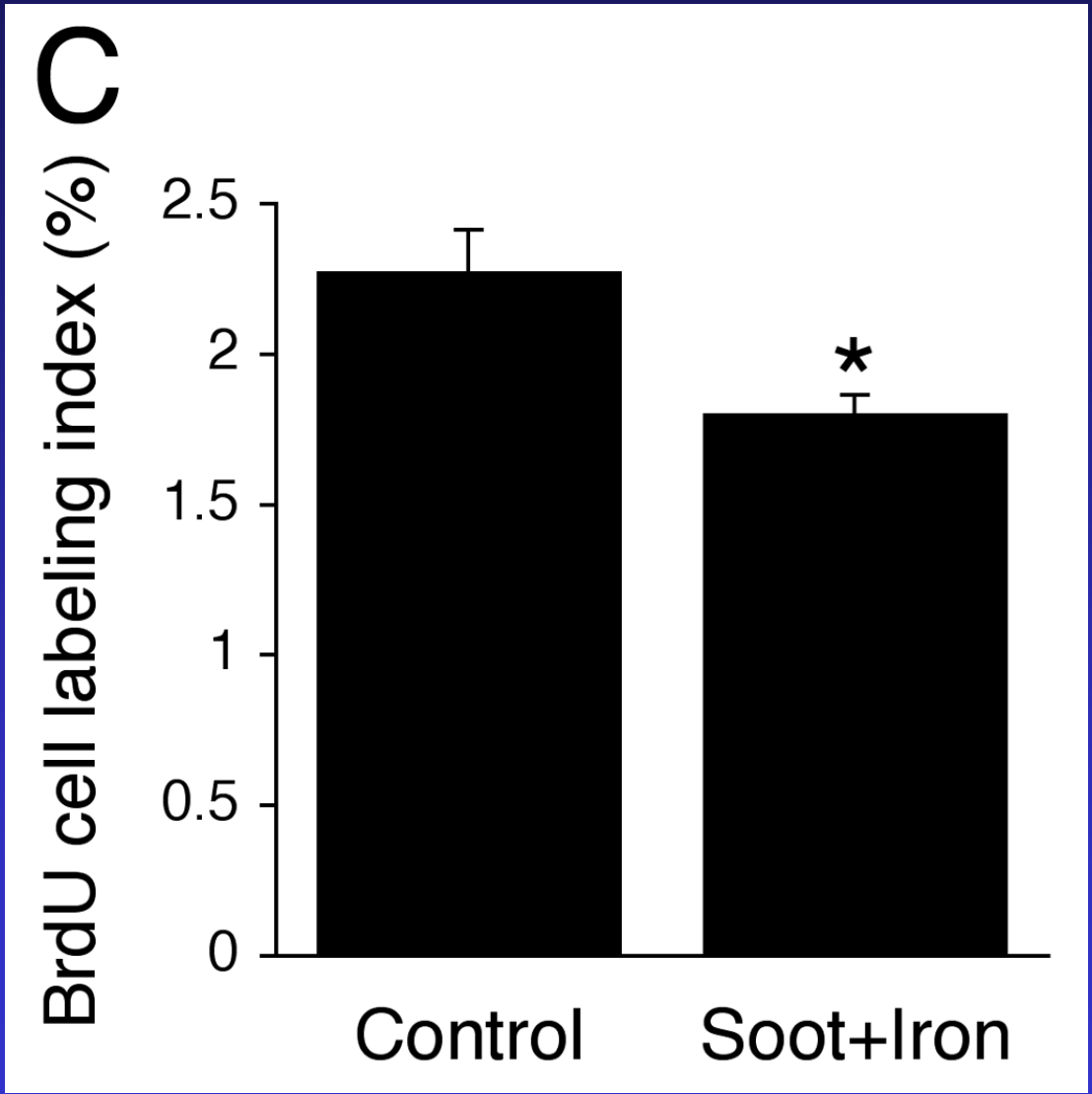
Terminal Bronchioles



Lung Parenchyma



Proximal Alveolar Region



Conclusions

1. Ambient fine and coarse particles can be used to study health effects.
2. Respiratory changes have been observed following exposure to concentrated ambient particles in the Central Valley of California.
3. The immediate adverse effects of particles are site-specific in the lungs of healthy adult rats.
4. Ultrafine soot and metal particles such as iron have an adverse synergistic effect on the lungs.
5. Combustion particles have subtle, but significant effects on lung growth during early life.

Acknowledgements

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Julian Recendez

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